Gyrokinetic simulations of turbulence and flows in limiter plasmas for midsized tokamaks

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Turbulence and plasma rotation in limiter L- and H-mode Textor plasmas [1] are investigated with the Elmfire code. The Elmfire gyrokinetic PIC code calculates the evolution of the full f distribution function for ions and electrons in time while taking Coulomb collisions into account allowing simultaneous solutions of neoclassical and turbulent physics in the presence of wide orbits, steep gradients and rapid dynamic profile changes. Steady state profiles are obtained by the balance of a heating model, particle/energy transport, radiation losses and energy transported to a limiter surface [3]. Much lower turbulence levels are found for the H-mode case compared to the L-mode case which is in agreement with the experimentally found 'silent stage' in the inter ELM period.

The contribution of the phase and E×B velocity to the poloidal rotation is analyzed and the decorrelation rate and probability distribution function of the turbulent fluctuations will be presented. The radial structure of the rotation shear and the radial electric field are compared to the experimental obtained values. A strong modification of the radial electric field profile within one orbit width from the last closed flux surface is observed for both the L- and H-mode. This result is in qualitative agreement with the results earlier obtained with the ASCOT particle code which includes only neoclassical effects [4]. In Elmfire simulations, where turbulence is included, the temporal electric field behaviour was observed to have a clear effect on the heat conductivity which is in agreement with the well established paradigm for the L-H transition.

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